# Repassivation Kinetics of Fe-20Cr-*x*Ni alloys (*x*=0~80 %) and Its Relationship with Stress Corrosion Susceptibility

EunAe Cho and HyukSang Kwon

Dept. of Materials Science and Eng., Korea Advanced Institute of Science and Technology, 373-1, KuSongDong, YuSongGu, TaeJon 305-701, KOREA

Abstracts

Repassivation kinetics of rapidly scratched scars on the surface of Fe-20Cr-*x* Ni alloys (*x*=0~80 %) in a chloride solution was examined using an ampero-chronometric method, and its relationship to stress corrosion cracking (SCC) susceptibility was explored. The repassivation kinetics was analyzed in terms of the current density flowing from the scratch, *i(t)*, as a function of the charge density that has flowed from the scratch, *q(t).* Repassivation on the scratched surface of the alloys occurred in two kinetically different processes; the reformed passive film initially nucleated and grew according to the place exchange model in which log *i(t)* is linearly proportional to *q(t)*, and then grew according to the high field ion conduction model in which log *i(t)* is linearly proportional to 1/*q(t)* according to the Eq. (1).

$$\log i(t) = \log A + \frac{BVzF\rho}{2.3Mq(t)} = \log A + cBV/q(t) \quad \text{.....(1)}$$

,where A and B is parameters associated with the activation energy for migration of mobile ion through passive film, *c* is a constant depending on the alloy/environment system, and *V*, F, and ρ is respectively potential drop across the film, Farady constant, and density of passive film.

The slope (*cBV*) determined from the log *i(t)* vs. 1/*q(t)* plot was found to be a quantitative measure of repassivation rate. The lower the value of cBV, the faster repassivated the alloy, thereby exhibiting the less susceptibility to SCC. The SCC susceptibility measured by slow strain rate tests was well correlated with the change in the *cBV* as a function of applied potential, solution temperature, and chloride concentration. Based on this correlation, a new method is proposed for the prediction of SCC susceptibility in terms of repassivation kinetics. The validity of this method was confirmed by applying the relationship between the changes in the *cBV* and the SCC susceptibility to the influences of Ni on the repassivation kinetics and SCC susceptibility of Fe-20Cr-*x*Ni (*x*=0~80 %) alloys.

KEY WORDS :, repassivation kinetics, scratching electrode technique, stainless steels, nickel, stress corrosion susceptibility, chloride solution.